April 2000 Highlights of the Pulsed Power Inertial Confinement Fusion Program

We hosted a three-day workshop on experiments and modeling related to wire-array z pinches. The 14 Z shots in April were 3 short-circuit shots to obtain equation-of-state (EOS) data by a new method, a 4th shot to diagnose the end-on dynamic hohlraum source for LANL, 2 LANL weapon physics shots using this source, 5 radiation effects shots with DTRA, and 3 LLNL shots to investigate accretion physics.

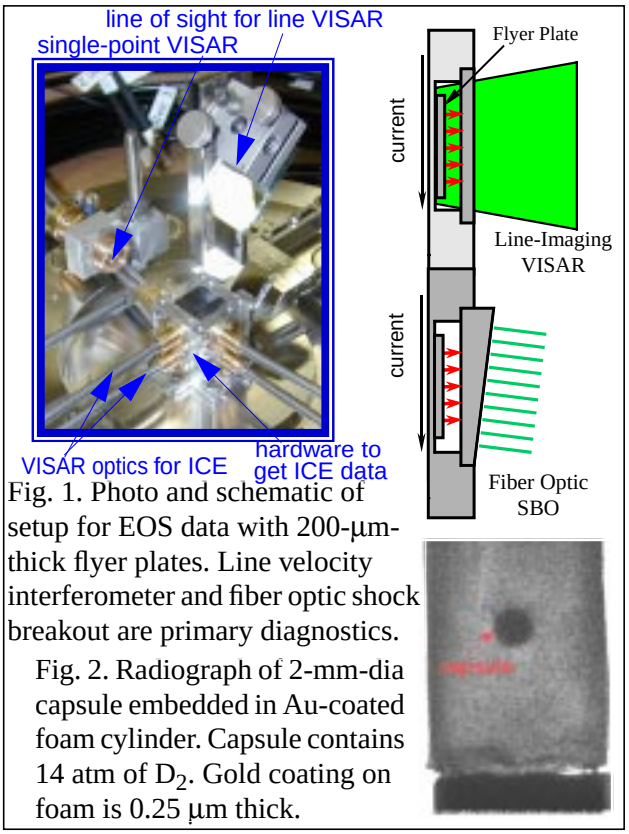

Fig. 1. Photo and schematic of setup for EOS data with 200-μm-thick flyer plates. Line velocity interferometer and fiber optic shock breakout are primary diagnostics.

Fig. 2. Radiograph of 2-mm-dia capsule embedded in Au-coated foam cylinder. Capsule contains 14 atm of D_2. Gold coating on foam is 0.25 μm thick.

We are evaluating a new method to launch hypervelocity, "cold" flyer plates using the magnetic pressure generated from a short-circuit load (Fig. 1). The shockless loading of the flyer plates keeps them at near ambient density and temperature at impact and will permit us to obtain accurate (gas-gun quality) EOS data. The measured velocities on Z shots 575 and 576 are record values for EOS-quality flyer plates: 13 km/s in Al (2.5 Mbars), 10 km/s in Cu, and 12.5 km/s in Ti. The results are in reasonable agreement with 1-D ALEGRA simulations. With some refinement of the method, 20 - 30 km/s (a few tens of Mbars) should be achievable. In May we will use this new technique to assess the shock response of liquid D_2 at pressures of 300 - 500 kbar. The Z data might resolve the discrepancy between Nova D_2 data and ab-initio calculations. On shots 575 and 576 we also produced significantly different thermodynamic states in Al and LiF, at pressures in excess of 1 Mbar, by the isentropic loading (ICE) technique; in doing so, we met a Q2FY01 milestone for Campaign 11.

A majority of Z experiments are affected by the dynamics of wire arrays. The initial condition of the wires (how current is applied for particular hardware arrangements, manufacturing processes, whether the wires are insulated or not, preheated or not, the wire orientation, etc.) are important. (For example, see *Highlights* for Feb., May, Nov. 97; Mar. 98; June, July, Nov., Dec. 99.) On April 4 - 6 we hosted a wire-array z-pinch workshop in Taos to discuss recent data and modeling relevant for high- and low-current devices and provide technical guidance for future research. Attendees were from Russia, France, Israel, Chile, England, and, in the US, Cornell, Univ. of Reno, UC Davis, Maxwell Physics International, Mission Research, Prism Computational Sciences, NumerEx, Polymath, DTRA, LANL, LLNL, NRL, and SNL. The fundamental challenges discussed were understanding and controlling the magnetic Rayleigh-Taylor instability, modeling both the magnetohydrodynamic (MHD) and non-MHD regimes of wire behavior--including that of a single wire, scaling the physics of arrays to larger drivers (where wire opacity becomes significant) and to longer implosion times, and developing new or improved diagnostics and interpreting the data.

An experimental series in June will measure x-ray radiation from D_2-filled capsules in a dynamic hohlraum environment. The design of the capsules and hohlraums is based on an extensive modeling effort using 2-D LASNEX. In preparation for these experiments, Schafer Corp. developed a method to embed a capsule within a foam cylinder (Fig. 2). Some of the cylinders will have a gold preheat layer. General Atomics will coat the capsules with polyvinyl alcohol to reduce the possibility of deuterium leakage.

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